

Final Program



Twenty-Ninth
Hanford Symposium
on Health and the
Environment

**INDOOR RADON AND LUNG CANCER:
*REALITY OR MYTH?***

October 15-19, 1990
Richland, Washington U.S.A.

Sponsored by
The United States Department of Energy and
Battelle, Pacific Northwest Laboratories

2025827340

Organizing Committee

Program

F. T. Cross, Chairman
L. A. Braby
A. L. Brooks
G. E. Dagle
E. S. Gilbert
A. C. James
J. R. Johnson
R. F. Jostes
J. A. Mahaffey
P. C. Owczarski

Technical Editors

R. W. Baalman
D. Felton

Local Arrangements

V. G. Horstman

Symposium Secretaries

T. A. Zinn
P. J. Vickerman

Word Processor

M. Cross

2025827341

Foreword

This symposium will address the most important public health issue in radiation today: Is indoor radon causing lung cancer? Radon gas in buildings is believed to be the most significant source of ionizing radiation in our environment, accounting for 50% or more of the total average effective dose equivalent to the human population. Abundant experimental animal data and epidemiological evidence from uranium miners and other underground miners confirm that radon progeny are carcinogenic. The evidence is less conclusive on the quantitative risks of these exposures, especially for indoor air.

The Twenty-Ninth Hanford Symposium on Health and the Environment will provide a forum to present and evaluate basic research data on the physical and biological mechanisms associated with, or related to, the health effects of indoor radon. The meeting will explore diverse methods and approaches, including statistical, biological and biophysical modeling, to provide perspective on this currently important public issue. Papers will treat all facets of the indoor radon issue, but emphasis will be placed on the main question: Is indoor radon causing lung cancer?

Proceedings

Papers presented will be published in a proceedings, to be distributed subsequent to the Symposium. A complimentary copy will be sent to each attendee.

2025827342

NOTES

2025827343

PROGRAM SUMMARY

Monday, October 15, 1990

7:00-10:00 p.m. Registration and Wine-Tasting Reception

Tuesday, October 16, 1990

7:30 a.m. Registration

8:15 a.m. Welcome/Introductions

Radon and Progeny Exposure Assessment

8:45 a.m. Measurement and Modeling of Exposure Levels

10:20 a.m. Break

10:40 a.m. Studies to Improve Exposure/Dose-Response
Relationships

11:55 a.m. Lunch

1:10 p.m. Studies to Improve Exposure/Dose-Response
Relationships (continued)

2:45 p.m. Break

Dosimetry Modeling

3:05 p.m. Invited Overview

3:40 p.m. Studies with Airway Casts

2025827344

- | | |
|-----------|--|
| 4:30 p.m. | <i>Herbert M. Parker Lecture Series--</i>
Open to the Public |
| 5:30 p.m. | Reception for H. M. Parker Lecturer |
| 7:20 p.m. | Studies with Airway Casts (continued) |
| 8:10 p.m. | Deposition and Fate of Inhaled Radon and
Radon Decay Products |
| 9:10 p.m. | Stochastic Dosimetry Methods |

Wednesday, October 17, 1990

Concurrent Sessions will be held on Wednesday.

First Group of Concurrent Sessions (Whitman Room)

- | | |
|------------|--|
| 8:15 a.m. | Radon Transport in Soils and Into
Structures |
| 10:20 a.m. | Break |
| 11:55 a.m. | Lunch |
| 1:15 p.m. | Radon and Radon Progeny
Sources |
| 2:50 p.m. | Break |
| 3:10 p.m. | Methods to Control Radon and
Radon Progeny Exposure |

2025827345

Wednesday, October 17, 1990

Second Group of Concurrent Sessions (Lewis & Clark Room)

8:15 a.m. **Molecular/Cellular-Level Studies**

10:05 a.m. Break

11:45 a.m. Lunch

1:05 p.m. **Molecular/Cellular-Level Studies**
 (continued)

1:55 p.m. **Animal Studies and Exposure Systems**

2:45 p.m. Break

7:00-10:00 p.m. *Cocktail Hour and Banquet*

Thursday, October 18, 1990

8:15 a.m. **Biological and Statistical Modeling Studies**

10:30 a.m. Break

10:50 a.m. **Epidemiologic Studies**

12:30 p.m. Lunch

1:45 p.m. **Epidemiologic Studies** (continued)

3:00 p.m. Break

Social Program: Spirit of Washington Dinner Train
 (*optional*)

2025827346

Friday, October 19, 1990

**8:10 a.m. Public Strategy, Information, and
Risk Communication**

9:50 a.m. Break

**10:10 a.m. Panel: Scientific Activities and
Programs to Understand and
Control Exposures to Radon**

12:10 p.m. Closing Remarks and Adjournment

2025827347

Twenty-Ninth Hanford Symposium on Health and the Environment—October 15-19, 1990

**INDOOR RADON AND LUNG CANCER:
REALITY OR MYTH?**

Monday, October 15, 1990

7:00-10:00 p.m. Registration and Wine-Tasting Reception

Tuesday, October 16, 1990

7:30 a.m. Registration

8:15 a.m. Welcome/Introductions

WJ BAIR, Manager, Life Sciences Center, Pacific Northwest Laboratory

JD WAGONER, Manager, Richland Operations, U.S. Department of Energy

WR WILEY, Director, Pacific Northwest Laboratory

FT CROSS, Symposium Chairman

2025827348

Tuesday

Technical Sessions

Tuesday, October 16, 1990

Radon and Progeny Exposure Assessment

Measurement and Modeling of Exposure Levels

Session Chairpersons: NH HARLEY, New York University, New York, NY, and EO KNUTSON, Environmental Measurements Laboratory, New York, NY.

8:45 a.m. LD BROWN. Control of Occupational Exposure to Radon in the Workplace. Saskatchewan Human Resources, Labor and Employment, Regina, Saskatchewan, Canada.

9:10 a.m. G SCIOCCHETTI, M BOVI, G COTELLESA, S TOSTI, PO BALDASSINI, and E SOLDANO. Dose Assessment of Population Groups Exposed to Elevated Radon Levels in Radioactive Italian Spas. ENEA-CRE, Rome, Italy.

9:35 a.m. GW EGERT,¹ RL KATHREN,² and FT CROSS.³ The Effect of Home Weatherization on Indoor Radon Concentration. ¹Westinghouse Hanford Company, Richland, WA. ²University of Washington, Seattle, WA and Hanford Environmental Health Foundation, Richland, WA. ³Pacific Northwest Laboratory, Richland, WA.

9:55 a.m. I MÄKELÄINEN, A VOUTILAINEN, and O CASTRÉN. Prediction of Indoor Radon Concentration Based on Residence Location and Construction. Finnish Centre for Radiation and Nuclear Safety, Helsinki, Finland.

10:20 a.m. Break

Studies to Improve Exposure/Dose-Response Relationships

Session Chairpersons: NH HARLEY, New York University, New York, NY, and EO KNUTSON, Environmental Measurements Laboratory, New York, NY.

10:40 a.m. YS CHENG and YF SU. Plate-Out Rates of Radon Progeny and Particles in Chambers. Inhalation Toxicology Research Institute, Albuquerque, NM.

11:05 a.m. P EKLUND and M BOHGARD. An Experimental Facility to Simulate Radon-Progeny Behavior in Dwellings. Lund Institute of Technology, Lund, Sweden.

11:30 a.m. C SAMUELSSON. Recoil-Deposited ^{210}Po in Radon Dwellings. University Hospital, Lund, Sweden.

11:55 a.m. Lunch

1:10 p.m. C LANDSHEERE, H VANMARCKE, and A POFFIJN. Experimental and Theoretical Study of the Fraction of ^{210}Po Absorbed in Glass. Nuclear Physics Laboratory, Ghent, Belgium.

Studies to Improve Exposure/Dose-Response Relationships
(continued)

1:35 p.m. C-S LI and PK HOPKE. Measurement of Size Distributions of Indoor Radioactive Aerosols. Clarkson University, Potsdam, NY.

1:55 p.m. A REINEKING, G BUTTERWECK, J KESTEN, and J PORSTENDORFER. Unattached Fraction and Size Distribution of Aerosol-Attached Radon and Thoron Daughters in Realistic Living Atmospheres and Their Influence on Radiation Dose. Isotopenlaboratorium für biologische und medizinische Forschung, Universität Göttingen, Federal Republic of Germany.

Tuesday

2:20 p.m. EO KNUTSON and AC GEORGE. Reanalysis of Data on the Particle-Size Distribution of Radon Progeny in Uranium Mines. Environmental Measurements Laboratory, New York, NY.

2:45 p.m. Break

Dosimetry Modeling

3:05 p.m. AC JAMES. (Invited Overview) Dosimetry of Radon Exposures: What Does It Imply for Risk and Measurement of Indoor Exposure? Pacific Northwest Laboratory, Richland, WA.

Studies with Airway Casts

Session Chairpersons: DL SWIFT, The Johns Hopkins University, Baltimore, MD and AC JAMES, Pacific Northwest Laboratory, Richland, WA.

3:40 p.m. M SHIMO¹ and A OHASHI.² Deposition Distribution of Unattached RaA Atoms in the Tracheobronchial Region. ¹Nagoya University, Nagoya, Japan. ²Ship Research Institute, Ministry of Transport, Tokyo, Japan.

4:00 p.m. DL SWIFT,¹ YS CHENG,² YF SU,² and HC YEH.² Design, Characterization and Use of Replicate Human Upper Airways for Radon Dosimetry Studies. ¹The Johns Hopkins University, Baltimore, MD. ²Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM.

4:30 p.m. **Herbert M. Parker Lecture Series**—Open to the Public. JOHN C. VILLFORTH. Radiation with an On/Off Switch. Former Assistant Surgeon General, U.S. Public Health Service and Director of the Center for Devices and Radiological Health, Food and Drug Administration, Washington, D.C.

5:30 p.m. Reception for H. M. Parker Lecturer

Studies with Airway Casts (continued)

Complimentary refreshments

7:20 p.m. JC STRONG¹ and DL SWIFT.² Deposition of "Unattached" Radon Daughters in Models of Human Nasal Airways. ¹National Radiological Protection Board, Chilton, Didcot, Oxon, United Kingdom. ²The Johns Hopkins University, Baltimore, MD.

7:45 p.m. HC YEH, YS CHENG, YF SU, and KT MORGAN. Deposition of Radon Progeny in Nonhuman Primate Nasal Airways. Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM.

Deposition and Fate of Inhaled Radon and Radon Decay Products

Session Chairperson: JR JOHNSON, Pacific Northwest Laboratory, Richland, WA.

8:10 p.m. GR CHAKRAVARTHY,¹ GI LYKKEN,² and JJ WORMAN.² Radon Uptake in Humans. ¹Radiation Oncology, United Hospital, Grand Forks, ND. ²University of North Dakota, Grand Forks, ND.

8:30 p.m. J RUNDO. Exhalation of Radon by Man. Argonne National Laboratory, Argonne, IL.

8:50 p.m. TD STERLING. Smoking-Produced Mucus and Clearance of Particles in the Lung. Simon Fraser University, Burnaby, British Columbia, Canada.

2025827352

Stochastic Dosimetry Methods

Session Chairperson: LE BRABY, Pacific Northwest Laboratory, Richland, WA.

9:10 p.m. RS CASWELL and JJ COYNE. Alpha Particle Spectra and Microdosimetry of Radon Daughters. National Institute of Standards and Technology, Gaithersburg, MD.

9:30 p.m. M ZAIDER. On the Nanodosimetry of Radon Alpha Particles. Center for Radiological Research of Columbia University, New York, NY.

9:50 p.m. DR FISHER,¹ TE HUI,¹ VP BOND,² and AC JAMES.¹ Microdosimetry of Radon Progeny: Application to Risk Assessment. ¹Pacific Northwest Laboratory, Richland, WA. ²Brookhaven National Laboratory, Upton, Long Island, NY.

Wednesday, October 17, 1990

Concurrent sessions will be held on Wednesday

First Group of Concurrent Sessions (Whitman Room)

Radon Transport in Soils and Into Structures

Session Chairpersons: GM REIMER, U.S. Geological Survey, Denver, CO and PC OWCZARSKI, Pacific Northwest Laboratory, Richland, WA.

8:15 a.m. G KELLER and M SCHÜTZ. Indoor Radon Sources and Radon Migration in the Soil. Universität des Saarlandes, Homburg/Saar, Federal Republic of Germany.

2025827353

8:40 a.m. FJ ALDENKAMP, P STOOP, ET LOOS, RJ DE MEIJER, and LW PUT. Measurements and Modeling of Radon Infiltration Into a Test Dwelling. Kernfysisch Versneller Instituut, Rijksuniversiteit Groningen, The Netherlands.

9:05 a.m. RB MOSLEY. A Simple Model for Describing Radon Migration and Entry Into Houses. U.S. Environmental Protection Agency, Research Triangle Park, NC.

9:30 a.m. KK NIELSON and VC ROGERS. Radon Transport Properties of Soil Classes for Estimating Indoor Radon Entry. Rogers and Associates Engineering Corp., Salt Lake City, UT.

9:55 a.m. TE BLUE, MS JARZEMBA, and JA MERVIS. Parameters that Characterize the Radon Hazard of Soils. The Ohio State Nuclear Engineering Program, Columbus, OH.

10:20 a.m. Break

10:40 a.m. DJ HOLFORD, PC OWCZARSKI, GW GEE, and HD FREEMAN. Statistical Uncertainty Analysis of Radon Transport in Nonisothermal, Unsaturated Soils. Pacific Northwest Laboratory, Richland, WA.

11:05 a.m. PC OWCZARSKI, DJ HOLFORD, HD FREEMAN, and GW GEE. Radon Transport from the Subsurface: The Roles of Certain Boundary Conditions at Subsurface/Environment Boundaries. Pacific Northwest Laboratory, Richland, WA.

11:30 a.m. TB BORAK, FW WHICKER, L FRALEY, MS GADD, SA IBRAHIM, FA MONETTE, R MORRIS, and DC WARD. Characterization of Radon Entry Rates and Indoor Concentrations in Underground Structures. Colorado State University, Ft. Collins, CO.

11:55 a.m. Lunch

2025827354

Radon and Radon Progeny Sources

Session Chairpersons: RF HOLUB, Bureau of Mines, Denver, CO and GM REIMER, U.S. Geological Survey, Denver, CO.

1:15 p.m. SL SZARZI, GM REIMER, and JM BEEN. Soil-Gas and Indoor Radon Distribution Related to Geology in Frederick County, Maryland.* U.S. Geologic Survey, Denver, CO.

1:25 p.m. JM BARNETT,¹ JW MC KLVEEN,¹ and WK HOOD, III.² Determination of Radon-222 in Ground Water Using Liquid Scintillation Counting—Survey of Carefree-Cave Creek Water Basin in Arizona. ¹Arizona State University, Tempe, AZ. ²Arizona Department of Environmental Quality, Phoenix, AZ.

1:50 p.m. M BALCÁZAR, A CHÁVEZ, and A LÓPEZ. Anomalous Indoor Radon Concentrations in a Research Reactor Building. Instituto Nacional de Investigaciones Nucleares, México, DF, México.

2:15 p.m. A BATTAGLIA,¹ D CAPRA,¹ G QUEIRAZZA,² and A SAMPAOLO.³ Radon Exhalation Rate from Coal Ash and Building Materials in Italy.* ¹CISE SpA, Segrate, Italy. ²ENEL/CRTN, Milan, Italy. ³ENEL/CRC, Brindisi, Italy.

2:25 p.m. RF HOLUB, RF DROULLARD, and TH DAVIS. "Orphan" Radon Daughters at the EPA Superfund Denver Radium Site. Bureau of Mines, Denver, CO.

2:50 p.m. Break

*Poster

Methods to Control Radon and Radon Progeny Exposure

Session Chairpersons: PK HOPKE, Clarkson University, Potsdam, NY and JCH MILES, National Radiological Protection Board, Chilton, Didcot, Oxon, United Kingdom.

3:10 p.m. BC KRAFTHEFER, and M SCHELL. Air Filtration and Health Risk in the Residence. Honeywell, Inc., Golden Valley, MN.

3:35 p.m. PK HOPKE, C-S LI, and M RAMAMURTHI. Air Cleaning and Radon Decay Product Mitigation. Clarkson University, Potsdam, NY.

4:00 p.m. TD PUGH,¹ MB GREENFIELD,¹ J MAC KENZIE,¹ and DE MEIJER.² Development of Apparatus and Procedures for Evaluating Radon-Resistant Construction Materials. ¹Florida A&M University, Tallahassee, FL. ²Kernfysisch Versneller Instituut, Groningen, The Netherlands.

4:30 p.m. M NUSS and S PRICE. Technical and Public Policy Considerations in the Development of a Code for the Control of Radon in Residences. Washington State Energy Office, Spokane, WA.

5:00 p.m. JCH MILES, KD CLIFF, BMR GREEN, and DW DIXON. Reducing Excessive Radon Exposures in U.K. Housing. National Radiological Protection Board, Chilton, Didcot, Oxon, United Kingdom.

2025827356